

Model Evaluation Overview

Groundwater Modeling Group Working Group (GMMWG) Meeting

DRAFT 10/12/2021 With MJT/EPA

DRAFT 10/1/2021 With DOH edits - blue slides and latest changes highlighted

DRAFT 10/01/2021 With additional EPA edits - red text



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Presentation Context

- The Navy submitted the Groundwater Flow Model Report in March 2020.
- The Regulatory Agencies (RAs) are working to determine the best path forward given the AOC schedule.
- Despite efforts made by Navy since the 2018 interim model, the Navy's current models need substantial modification to better represent field conditions and complexity.
- The RA SMEs are using this opportunity to present and discuss some of their comments and concerns from their review of the Groundwater Flow Model Report and accompanying model files.



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Key Overarching Goal

- The purpose of the flow modeling is to refine past models and improve understanding of the directions and rates of flow within aquifers around the Facility (*after AOC, 2015*):
 - To accomplish this, representation of geologic conditions must be revised and better understood in light of new data not available to prior modeling efforts
 - Those improvements are intended to provide suitable foundations for (a) modeling the dissolved-phase aspects of CF&T and (b) informing fuel-transport understanding and evaluation.
- The GWFMs would then be used to evaluate potential impacts of, and mitigation strategies for, releases at RHBSF and help inform TUA/IRR decisions.



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Regulator Perspective on GWFMs

- The GWFMs do not at this time provide a reliable basis to evaluate potential aquifer impacts or the risk posed from releases at RHBSF.
- This is, in part, due to simplified representations of geologic conditions and complexity using equivalent porous media (EPM) and uniformity assumptions.



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Modeling and Decision Support

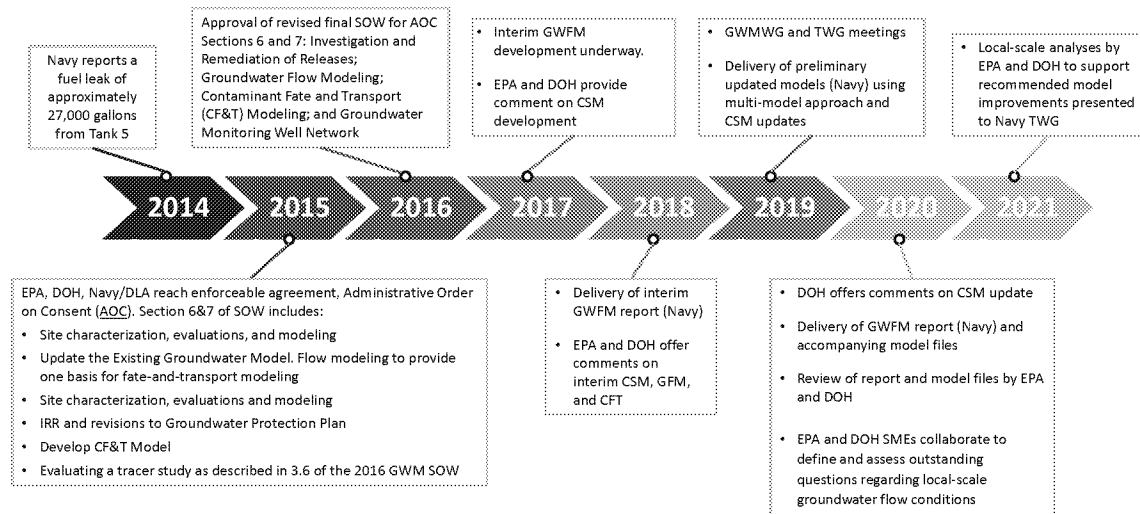
- It is important to understand that the GWFM's cannot alone address fuel (product) migration and mitigation:
 - Risk and mitigation strategies will be driven by fuel release conditions
 - Simplified representation of RH ridge and steady-state approach limit utility
 - Hydraulic containment is not the only potential mitigation strategy
- Reliable evaluations need a link to fuel transport



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Project Overview and Timeline



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Summary of EPA/DOH Review of GWFMR and Files

- Knowledge of the subsurface has advanced considerably since the execution of the AOC. Still, the GWFMs are not ready to support decision making and planning:
 - Conditions and patterns close to RHBSF are not accurately reproduced
 - No single model incorporates all potentially important features, events, and processes at a scale & complexity appropriate to the Red Hill hard-rock setting
 - Correspondence between models and data must improve to produce “behavioral” models for capture and transport analysis and emphasize transient conditions
 - Lessons learned require further analysis, discussion, and integration
- For example: the Navy’s TUA proposal states that modeling demonstrates that RHS can capture water beneath RHBSF if pumped at a rate of 5-10 MGD:
 - Groundwater capture is undemonstrated and alone, does not encompass all regulatory concerns regarding groundwater protection measures
 - Though the current models may provide insights into regional conditions, they are not ready to represent transport and risk at RHBSF
 - Limited, local-scale analysis may help understand conditions to “feed back” to the Navy models



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Summary of EPA/DOH Review of GWFMR and Files

- Below are primary concerns that the Regulators share regarding (a) the CSM and (b) the GWFMs, that should be the focus of the next iteration of work:
 - Extent, role, and representation, of saprolites (*item 2 of "Top Ten Regulatory Concerns"*). Work has been performed on this but a best-estimate extent and configuration of saprolite features has not been determined, and their representation in the models may not reflect their actual role on migration.
 - Role of heterogeneity and preferential pathways on mixing, transport, fate, and capture (*items 4 and 5 of "Top Ten Regulatory Concerns"*).
 - Calibration to groundwater head differences (gradients), absolute heads (*item 6 of "Top Ten Regulatory Concerns"*), and transient head responses.
 - Correspondence between simulated flow patterns and groundwater chemistry data (*item 9 of "Top Ten Regulatory Concerns"*).
 - Lack of adequate justification for model parameter ranges far outside of Hawaiian norms
- Resolving these concerns is challenged by monitoring data spatial sparsity and conflicts between observed chemistry and (presumed) groundwater flow rates and directions.

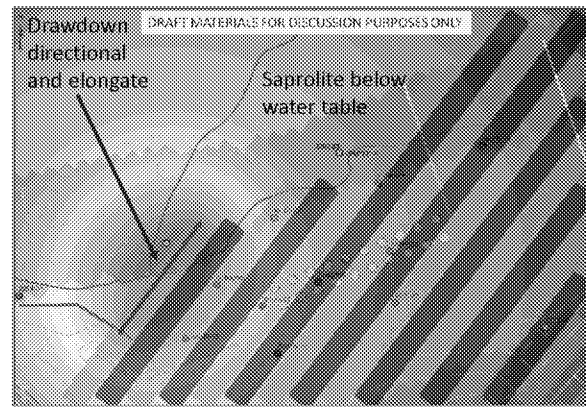


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Example: Representation of Subsurface Heterogeneity

- There is abundant evidence for hydraulic property contrasts in basalt. The Navy represents this with an EPM, directional anisotropy and - for some models - pilot points.
- Alternative methods for representing basalt-character heterogeneity should be considered that provide more realistic parameter fields.
- Additional field data could potentially validate flow rates and directions - such as in-well and inter-well tracer tests.



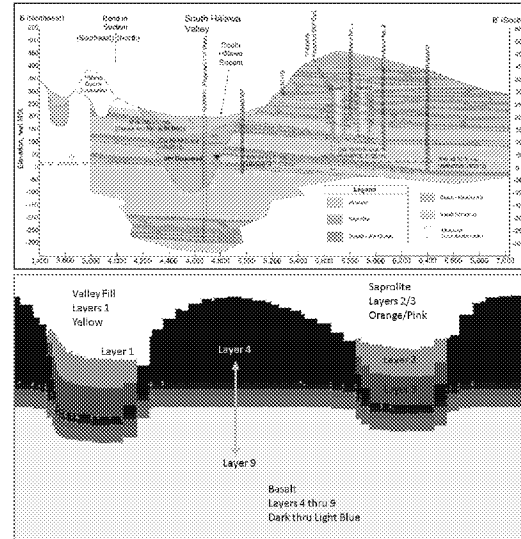
■ Schematic lava flows
□ (dense interiors vs clinker)



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Example: Model Layering

- Use of topographic and structure-following layer approach may have some unintended consequences for transport pathways.
- Evaluate alternate methods to represent transitions between Hydro-stratigraphic units (HSUs) and role of saprolite.



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Comparing Model Output with Actual Data

- If model results compare unfavorably with observations, then it can be concluded that something is wrong in the model
- If model results compare favorably with observations, this does not necessarily guarantee that the model is reliable

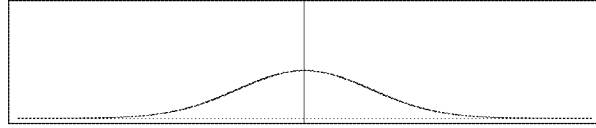
Oreskes, N., K. Shrader-Frechette, and K. Belits. 1994. Verification, validation, and confirmation of numerical models in the earth sciences. Science 264, 641-646



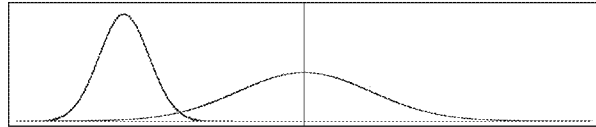
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Comparing Model Output with Actual Data

- We don't know gradient and flow directions with high confidence: they present as a wide, flat normal curve.
- The data are what they are.
- But we can know if the model outputs reasonably correspond with the measured data
- The normal curves only show marginal overlap.



"Data"



"Model"

"Data"



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Technical Presentation Overview

- On Day 2, the RAs and SMEs will (a) review key CSM assumptions that do not align with field data and (b) provide a technical presentation to illustrate one approach to evaluating certain features of the local CSM.
- Although the work that will be presented uses modeling techniques, it is not a replacement for Navy model, rather a collaborative effort by the regulator SMEs to evaluate certain challenging aspects of the local groundwater system.



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Add Slide to address Gary's comment

- Added two slides (11 and 12)



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